

Interactions among Active Galaxies: An HI Perspective

Jeremy Lim, Cheng-Yu Kuo

Institute of Astronomy & Astrophysics, Academia Sinica, Taiwan

Wen-Shuo Liao

Department of Physics, National Taiwan University, Taiwan

Jenny Greene, Paul T. P. Ho

Smithsonian Astrophysical Observatory, Cambridge, USA

Abstract. Galaxy-galaxy interactions is one of the leading candidates for triggering nuclear activity in galaxies. Such interactions are thought to be able to bring a fresh supply of gas to the center of a galaxy to fuel its resident supermassive black hole. Optical observations, however, do not reveal direct evidence for interactions among the majority of active galaxies. On the other hand, neutral atomic hydrogen (HI) gas has proven to be an exquisite tracer of galaxy-galaxy interactions, even when no such interactions are visible in the optical. Here, we describe our systematic HI imaging surveys of galaxies hosting active galactic nuclei (AGNs) and quasi-stellar objects (QSOs), and present a few illustrative results.

Observations and Results

We are conducting two HI-imaging surveys of active galaxies with the Very Large Array (VLA). The first targets all QSOs (defined to have $M_B < -23$ for $H_o = 50 \text{ Mpc}^{-1} \text{ km s}^{-1}$) at redshifts $z < 0.07$ and declinations $\delta > -40^\circ$ in the Véron-Cetty & Véron catalog (1998). The second targets all AGNs with $-19 \geq M_B \geq -23$ at $0.015 < z < 0.017$ and $\delta > 0^\circ$ in the same catalog.

In Figure 1, we show a few illustrative results from our surveys. In optical starlight, these galaxies are not visibly interacting, nor do they appear disturbed. In dramatic contrast, our HI images show that all are interacting with neighboring galaxies; in the case of WAS 26, the candidate interacting neighboring galaxy lies outside the field shown. We anticipate that these surveys, when completed, will provide an improved understanding of the importance of galaxy-galaxy interactions in triggering nuclear activity.

References

Véron-Cetty, M. P. & Véron, P. A. 1998, A Catalogue of Quasars and Active Galactic Nuclei (ESO Sci. Rept.) (8th ed.; Garching:ESO)

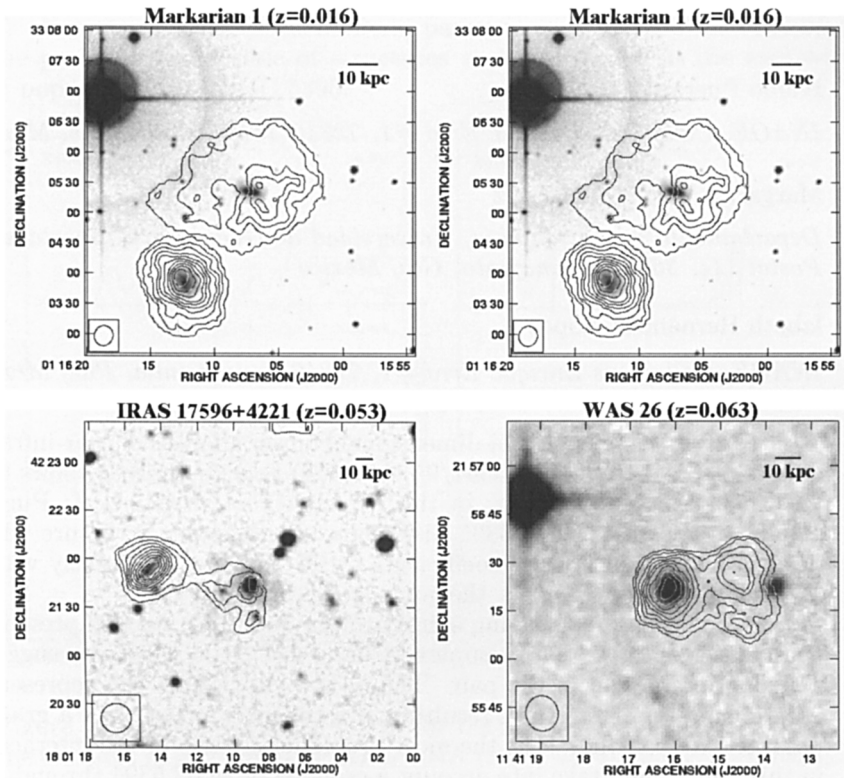


Figure 1. Contours of the HI-line integrated intensity superposed on negative grayscale optical images from the Digitized Sky Survey. The AGN or QSO is at the center of each panel. Also visible are interacting neighboring galaxies; a neighboring galaxy that appears disturbed in HI lies ~ 90 kpc in projection from WAS 26, and is not shown in this closeup figure of the QSO host galaxy. For the Seyferts Markarian 1 and ARK 539, contours are plotted at 1%, 10%, 20%, ... 90% of the peak intensity, which corresponds to a column density of $1.8 \times 10^{21} \text{ cm}^{-2}$ and $1.6 \times 10^{21} \text{ cm}^{-2}$ respectively for these two galaxies. For the QSOs IRAS 17596+4221 and WAS 26, contours are plotted at 10%, 20%, ..., 90% of the peak intensity, which corresponds to a column density of $2.6 \times 10^{21} \text{ cm}^{-2}$ and $3.6 \times 10^{21} \text{ cm}^{-2}$ respectively for these two galaxies. The synthesized beam is plotted at the lower left corner and a scale size of 10 kpc indicated at the upper right corner, of each panel. All quantities are computed with $H_0 = 70 \text{ Mpc}^{-1} \text{ km s}^{-1}$ and $\Omega_o = 1$.